# PosiTest® AT

## Pull-Off Adhesion Testers

**Quick Guide v. 5.0**

***PosiTest AT-A***
*(automatic)*

***PosiTest AT-M***
*(manual)*

DeFelsko®
The Measure of Quality

IP65

## Introduction

The **PosiTest AT** ***Pull-Off Adhesion Tester*** measures the force required to pull a specified test diameter of coating away from its substrate using hydraulic pressure. The pressure is displayed on a digital LCD and represents the coating's strength of adhesion to the substrate.

In accordance with ASTM D4541, D7234, ISO 4624 and others, the ***PosiTest AT*** evaluates the adhesion (pull-off strength) of a coating by determining the greatest tensile pull-off force that it can bear before detaching. Breaking points, demonstrated by fractured surfaces, occur along the weakest plane within the system consisting of the dolly *(loading fixture, stub)*, glue, coating layers and substrate.

This quick guide summarizes the basic functions of the instrument. Download a full instruction manual at: www.defelsko.com/manuals

## Basic Steps to Perform a Pull-Off Test

**1. Dolly & Coating Preparation**
The dolly and the coating are cleaned and abraded (see pg. 2).

**2. Glue & Dolly Application**
The glue is prepared and applied to the dolly. The dolly is is then adhered to the coated surface and the glue is allowed to cure (see pg. 2).

**3. Test Area Separation -** *optional*
The test area of the coating is isolated from the area surrounding the dolly by cutting or drilling (see pg. 3).

**4. Pull-Off Test**
a) PosiTest AT-M (manual) (see pg. 5)
b) PosiTest AT-A (automatic) (see pg. 7)

**5. Analysis of Test Results**
The dolly and the coating are examined and evaluated to determine the nature of the coating failure (see pg. 4).

## Dolly & Coating Preparation

**Dolly Preparation**

1. To remove oxidation and contaminants, place the included abrasive pad on a flat surface and rub the base of the dolly across the pad 4-5 times.
2. As required, remove residue left from the abrading process using a dry cloth or paper towel.

**Coating Preparation**

1. Lightly roughen the coating using the included abrasive pad.

NOTE: As coating abrasion may introduce flaws, it should only be used when necessary to remove surface contaminants, or when the bond strength between the glue and the coating is insufficient for pull testing.

2. To promote the bond between the dolly and the coating, degrease the area of the coating to be tested using alcohol or acetone to remove any oil, moisture or dust.

NOTE: Ensure that any alternative abrasion techniques, degreasers or adhesives do not alter the properties of the coating. Test by applying a small amount of degreaser or glue to a sample area and observing effects.

## Glue & Dolly Application

**Glue Selection**

The glue included in the PosiTest Adhesion Tester kit has been selected due to its versatility. This glue has minimal impact on a variety of coatings and has a tensile strength exceeding the maximum performance capabilities of the pressure system under ideal conditions. Other glues may be preferred based on requirements such as cure time, coating type, working temperature and pull-off strength. Quick curing one-part cyanoacrylates (super glues) may be sufficient for painted surfaces, but two-part epoxies are preferred for porous or rough coatings.

**Dolly Application**

1. Mix the glue per manufacturer's instructions and apply a uniform film of glue on the base of the dolly
2. Attach the dolly to the prepared coating test area.

NOTE: If the coated surface to be tested is overhead or vertical, a means to hold the dolly in place during the cure time may be required, i.e. removable tape.

3. Gently push down on the dolly to squeeze out excess adhesive. Do not twist or slide the dolly back and forth on the coating as air bubbles may be generated.
4. Carefully remove excess adhesive from around the edges of the dolly with included cotton swabs.
5. Allow to cure per the adhesive manufacturer's instructions.

## Test Area Separation

The decision of when to cut around a dolly is dependent on the standard, specification or contractual agreement to which the test is to comply. The primary purpose for cutting through the coating is to isolate a specific diameter test area. When the decision to cut into the coating has been made, it is recommended to cut all the way through to the substrate. As a minimum, it is suggested to carefully cut away excess glue from the dolly application process. This typically prevents a larger area of coating from being pulled away from the substrate, resulting in a higher pull-off pressure.

**Cutting Instructions**

1. Cut through the coating around the edges of the dolly with the included cutting tool, removing any excess glue.
2. Clear away any debris from the cutting process.

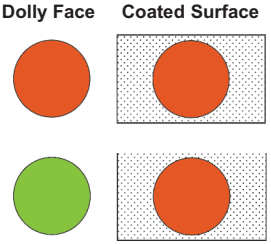
NOTE: **-** Cutting may induce coating surface flaws such as microcracking that may alter test results.
**-** For coatings with strong lateral bonding, it is recommended to cut completely through the coating down to the substrate.

**Drilling Template**

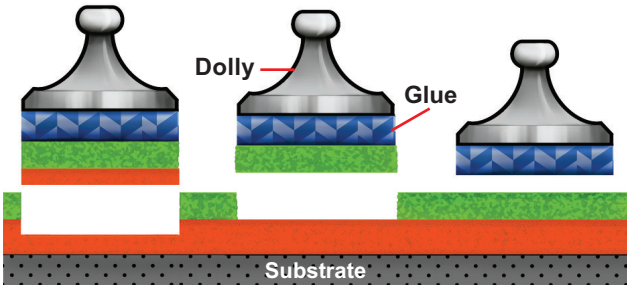
When testing very thick coatings, an optional drilling template may be preferred.

## Analysis of Test Results

Upon completion of the pull-off test, the dolly and coated surface should be examined. In addition to pull-off force, many National and International standards such as ASTM D4541 and ISO 4624 require the nature of the fracture to be recorded.



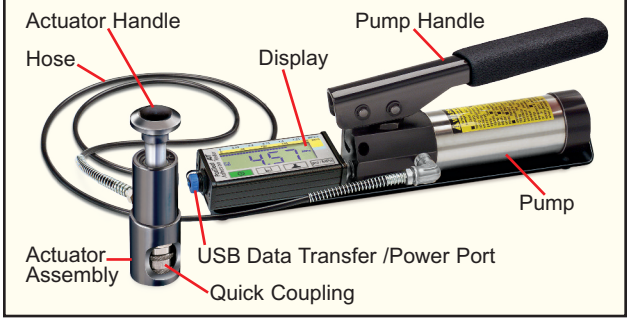

- *Cohesive* fracture: fracture occurs within a coating layer (same coating on dolly face and coated surface).
- *Adhesive* fracture: fracture occurs at the interface between layers (coating on dolly face differs from surface).
- *Glue* failure: visible separation of the glue from itself, the coating or dolly (no coating visible on the dolly face).




| **Cohesive fracture** (intercoat) | **Adhesive fracture** (between layers) | **Glue failure** (coating/glue) |
|---|---|---|

Glue failures typically occur when the glue is improperly mixed or the coated surface has not been adequately prepared (see pg.2).

The PosiTest *AT-A* model provides an interface to document the nature of the fracture for each pull-off test (see pg. 10). Fracture results are included in test reports.

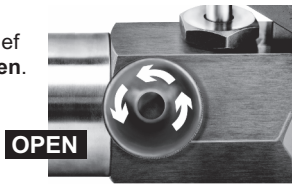



The *PosiTest AT-M* powers-up and displays dashes when the ⏻ button is pressed. To preserve battery life, the instrument powers-down after 5 minutes of no activity.

**Quick Guide**

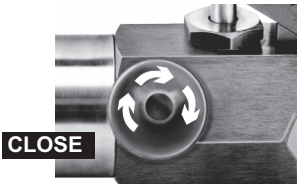
(1) **Open** pressure relief valve completely *(turn counter clockwise)*
(2) **Connect** the actuator to the dolly
(3) **Close** the pressure relief valve completely *(turn clockwise)*
(4) **Zero** - Press the ⏻ button
(5) **Pump** pressure into the system until the dolly pulls

**1.** Ensure the pressure relief valve is **completely open**. (turn counter clockwise)




**2.** Push the actuator handle completely down into the actuator assembly. Place the actuator over the dolly head and attach the quick coupling to the dolly by reaching through the holes in the actuator and lifting the coupling. Release the quick coupling when the dolly head is completely engaged.

**3.** Close the pressure relief valve on the pump **completely** *(turn clockwise).*




As required, verify and adjust the dolly size by pressing the button. Select the pressure units by pressing the psi/MPa button. The instrument will maintain these settings even after the button is pressed.

**4.** Zero the instrument **BEFORE** pumping by pressing the button. This prepares the instrument for the test by clearing the display, and zeroing the instrument.

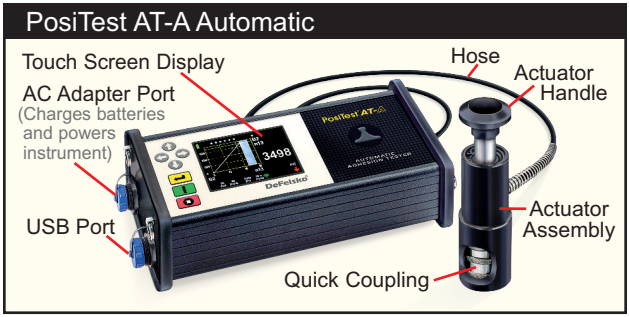
**5.** Prime the pump slowly until the displayed reading approaches the priming pressure. The priming pressure is the point that the instrument begins calculating and displaying the pull rate. It is also the pressure at which the ability to store readings is enabled. Priming pressures for the various dolly diameters are:

| | | |
|---|---|---|
| 10 mm | 400 psi | 2.8 MPa |
| 14 mm | 200 psi | 1.4 MPa |
| **20 mm** | **100 psi** | **0.7 MPa** *(default setting)* |
| 50 mm | 50 psi | 0.4 MPa |

For optimum results, prior to exceeding the priming pressure, return the pump handle to its full upright position and then complete a ***single continuous stroke*** at the desired pull rate until the actuator separates the dolly from the coating.

**6.** Open the pressure relief valve and remove the dolly from the actuator assembly.

**7.** Readings may be stored into memory by pressing the button (memory storage for up to 200 pulls). Press again to review stored readings. Stored measurements can be accessed using our *PosiSoft* 3.0 desktop software (pg. 14).




The *PosiTest AT-A* powers-up when the button is pressed. To preserve battery life, the instrument powers-down after 5 minutes of no activity. Alternatively, press and hold the button for 5 seconds or select *Power Off* from the menu.

Instrument functions are menu controlled. To access the Menu, press the button. Navigate using the *multifunction keypad* or *touch screen display*.

**Multifunction Keypad**

Directional buttons are used to navigate through menu options and adjust parameters.

*Note: Some menus display on more than a single view. Use the or buttons or swipe the touch display to switch between views.*

Access Menu / Select

Power On / Start Test / Return to Main View

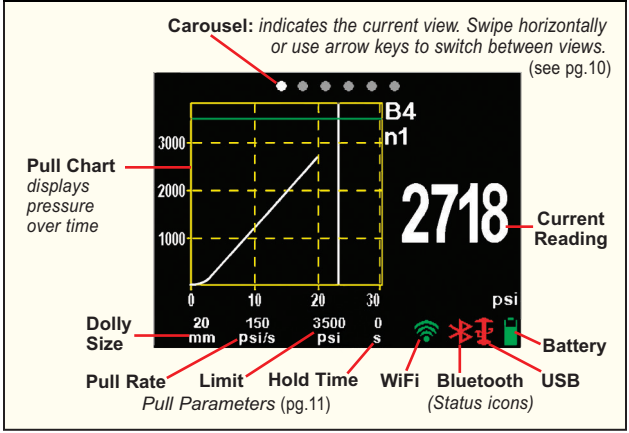
Stop Test / Power-down (hold for 5 seconds)

Screen Capture: Press both buttons at any time to copy and save an image copy of the the current display. The last 10 screen captures are stored in memory and can be accessed when connected to a computer (see *PosiSoft USB Drive* pg. 14).

### Touch Screen Display

Use the touch screen to interact with menu options. Swipe *horizontally* to navigate between views or *vertically* to move between batch readings. Alternatively, the directional buttons can be used for navigation.

**Main View** *(shown with memory batch open)*




## How to Measure

### Prepare the Instrument

1. Push the actuator handle completely down into the actuator assembly. Place the actuator over the dolly head and attach the quick coupling to the dolly by reaching through the holes in the actuator and lifting the coupling. Release the quick coupling when the dolly head is completely engaged.

2. Press the button to power-up the instrument if necessary.

3. Verify **Pull Parameters** (pg. 11) are set to the preferred *dolly size*, *pull rate*, *pull limit* and *hold time*. Change if necessary.

NOTE: If recording of test results is desired, a memory batch must be opened prior to the test. Select *New Batch* from the *Memory* menu (pg. 11).

**Perform the Test**

**4.** Press the button to initiate the test.

■ The instrument begins building pressure (priming stage) and a green animated arrow (up) appears on the display. When the priming pressure is achieved the LCD starts displaying pressure over time on the pull chart. Refer to step 5 (pg. 6) for *Priming Pressures*.

■ Pressure build-up stops when the dolly is pulled from the surface, the *pull limit* has been reached or when the button is pressed. The maximum pressure value will blink on the display and a red animated arrow (down) will display while the pump retracts the actuator.

**CAUTION:** ***To avoid injury, keep fingers away from the quick coupling and actuator assembly until the pull test has completed and the actuator has been fully retracted. Press the stop button to abort the pull test at any time.***

NOTE: Setting a *Pull Limit* or stopping the test before a fracture occurs is useful when the coating strength exceeds specified requirements.

**5.** Remove the dolly from the actuator assembly.

**6.** Examine the dolly and surface to analyze the result (pg. 4).

**Recording the Result**

If a memory batch is open, the maximum pressure result is automatically stored into memory (pg.11). Pass/fail, pull parameters, date and time are also recorded.

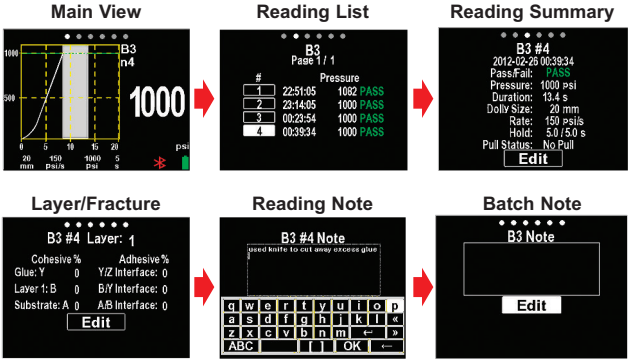
The nature of the fracture (cohesive, adhesive, glue), batch and reading notes can also be recorded. Swipe the touch screen horizontally or use the left/right buttons to navigate to the appropriate view and select *Edit*. See *Memory Views* (pg. 10).

All stored measurement data can be accessed using *PosiSoft* solutions (pg. 13).

**Memory Views** *(carousel)*

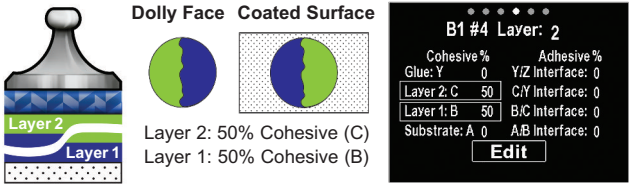
When a memory batch (pg. 11) is open, a carousel appears at the top of the display. Views are represented by dots, the solid dot indicates the current view.

Swipe *horizontally* to navigate between views or *vertically* to move between batch readings. Alternatively, the directional buttons can be used for navigation. Six views are available:




**Recording Fracture Analysis**

The cohesive and adhesive fracture visual analysis results can be recorded (available for up to 5 coating layers).




Fracture analysis is beyond the scope of this quick guide. Refer to the full instruction guide for a detailed overview of fracture analysis and recording.

## Memory Menu

The PosiTest *AT-A* stores 100,000 readings in up to 1,000 batches. *Stored measurements can be reviewed on-screen or accessed via computers, tablets and smart phones.*

New Batch

*Closes any currently opened batch and creates a new memory batch, named using the lowest available number (example: B2). New batches are date stamped when they are created.*

Open

Selects a previously created batch to open and make current.

Close

Stops the recording process, closes the current batch, and removes batch information from the display.

Delete

Removes a batch and associated measurements from memory.

NOTE: For further details on memory options, refer to the full instruction manual at: www.defelsko.com/manuals

## Setup Menu

Pull Parameters

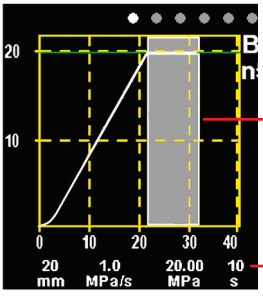
Select desired parameter using the buttons or touch screen. Use the and buttons to adjust.

**Dolly Size:** Select the dolly size being utilized for the test (10, 14, 20 or 50 mm)

**Rate:** User selectable pull rate (unit/sec). Specified rate is maintained for the duration of the test.

**Limit:** Pressure will build-up until the set *Limit* is reached or the dolly is pulled from the surface, whichever occurs first. By default, the instrument will pull to maximum for selected dolly size (see *Technical Specifications* pg. 16).

**Hold Time:**
*(up to 60 seconds)* pressure is maintained *(held)* at defined *Limit*. Default: 0 seconds.




### Orientation

Rotates display between landscape *(default)* or portrait views. Ideal for use in horizontal or vertical positions.

### Units

Converts the display from psi, MPa, N/mm$^2$ or Newtons (unit of force). Existing measurements in memory are not converted. Switching units closes *Memory*.

### Gage Info

Displays the model number & serial number, *PosiSoft.net* registration key, the amount of remaining memory for storage of readings, date and time, and software packages.

For security purposes, the registration key is required to add the Gage to your *PosiSoft.net* account (pg. 14).

### Reset

*Restores factory settings and returns the instrument to a known condition. The following occurs:*

- *All batches, stored readings, notes, batch names and screen captures are erased.*
- *Menu settings are returned to the following:*

| | | |
|---|---|---|
| **Memory** = OFF | **Bluetooth** = ON | **Units** = psi |
| ***Pull Parameters*** = *default* | **WiFi** = OFF | **Backlight** = Sun |
| **Orientation** = Landscape | **USB Drive** = ON | ***Language*** = *English* |

NOTE: *Date, Time and WiFi are not affected by a* ***Reset****.*

## Connect Menu

PosiSoft.net

Select ***Sync Now*** to immediately synchronize stored measurement data via USB or WiFi to *PosiSoft.net* (pg.14). *PosiSoft Desktop Manager* and an internet connection are required when using USB.

The instrument automatically attempts synchronization with PosiSoft.net when initially connected via USB to a PC running *PosiSoft Desktop Manager*.

NOTE: Additional measurements added to memory while connected are synchronized only when the USB cable is disconnected, then reconnected or when the *Sync Now* option is selected.

USB Drive ✓

The instrument uses a USB mass storage device which provides a simple interface to retrieve data in a manner similar to USB flash drives, cameras or digital audio players.

Bluetooth Smart ✓

Allows communication with a smart device running the *PosiTector App* (pg.14) via Bluetooth® wireless technology. No pairing required. When connected, measurement data is automatically transfered. Select ***Send Now*** to manually transfer batches (useful when switching between smart devices).

WiFi

Allows wireless communication with devices such as tablets, smart phones and computers connected to your local wireless network or portable mobile hot spot. See www.defelsko.com/WiFi

Updates

Determines if a software update is available for your instrument. See www.defelsko.com/update

WARNING:

The instrument will perform a ***Reset*** after an update (pg. 12).

## Accessing Stored Measurement Data

PosiSoft solutions for viewing, analyzing and reporting data:

**PosiTest AT (all models)**

- **PosiSoft 3.0** - Desktop software for downloading, viewing, printing and storing measurement data.

  Customizable reporting tools allow you to add pictures and screen captures, notes and annotations, add or remove sections (drag and drop), change headings and more. Save your custom layouts as templates for future use.

**PosiTest AT-A**

In addition to *PosiSoft 3.0*, the PosiTest *AT-A* is also compatible with the following solutions...

- **PosiSoft USB Drive** - connect to a PC/Mac using the supplied USB cable to access and print stored readings, graphs, notes and screen captures. No software or internet connection required. *USB Drive* must be selected. (see pg.13)

  **PosiSoft.net** - a free web-based application offering secure centralized storage of instrument readings. Access your data from any web connected device. Go to: www.PosiSoft.net

- **PosiTector App** - Wirelessly transfer measurement data to your *Apple iOS* or *Android* smart device. Create, customize and share professional PDF reports quickly and easily. The PosiTector App is available on the *iTunes App Store* and *Google Play*.

For more information on the PosiSoft suite of software, visit:
www.defelsko.com/posisoft

## Power Supply / Charging

***PosiTest AT-M*** *(manual)*

*Power Source: Built-in rechargeable NiMH battery***
*~60 hours continuous with full charge*

*The built-in rechargeable NiMH batteries are charged using the included USB AC power supply/charger. Ensure batteries are charged prior to use. The battery icon will blink while the instrument is charging and disappear when fully charged. The charging process will take up to 14 hours depending on remaining battery power.*

*Alternatively, the AC power supply or any computer USB port can be used to power and charge the instrument.*

*****Do not attempt to remove or replace the PosiTest AT-M internal NiMH battery pack. In the unlikely event power issues are experienced, please contact our technical support for assistance.***

***PosiTest AT-A*** *(automatic)*

*Power Source: Built-in rechargeable NiMH battery*
*>200 pulls with full charge*

*The built-in rechargeable NiMH batteries are charged using the included AC power supply/charger. Ensure batteries are charged prior to use. The USB port will not charge or power the PosiTest AT-A.*

*The charging process will take 2-3 hours depending on remaining battery power. Alternatively, the AC power supply can be used to power the instrument.*

*The* *icon will display while the instrument is charging.*
*When fully charged the* *icon will appear.*

NOTE:

*The PosiTest AT-A internal NiMH battery pack is user replaceable. In the unlikely event power issues are experienced, please contact our technical support or your local dealer for OEM battery pricing, availability and detailed replacement instructions.*

## Calibration and Verification

### Calibration

The PosiTest *AT* is shipped with a Certificate of Calibration showing traceability to a national standard. For organizations with re-certification requirements, the PosiTest *AT* may be returned at regular intervals for calibration. DeFelsko recommends that our customers establish their instrument calibration intervals based upon their own experience and work environment. Based on our product knowledge, data and customer feedback, a one year calibration interval from either the date of calibration, date of purchase, or date of receipt is a typical starting point.

### Verification

The PosiTest *AT* Verifier is available for verifying the accuracy and operation of *PosiTest Adhesion Testers* and is an important component in fulfilling both ISO and in-house quality control requirements. Fully portable with hardshell carry case for use in the field or laboratory. Learn more at: www.defelsko.com/at/verifier

## Technical Data

Conforms to: ASTM D4541, ASTM D7234, ISO 4624 and others.

**Specifications:**

**Resolution:** 1 psi (0.01 MPa) **Accuracy:** ±1% Full Scale

| Dolly Size (mm) | Max Pull-Off Pressure (AT-M) | Max Pull-Off Pressure (AT-A) |
|---|---|---|
| 10 mm | 10,000 psi (70 MPa) | *14,000 psi (96 MPa)* |
| 14 mm | 6,000 psi (40 MPa) | 7,000 psi (50 MPa) |
| 20 mm | 3,000 psi (20 MPa) | 3,500 psi (24 MPa) |
| 50 mm | 500 psi (3.5 MPa) | 560 psi (3.8 MPa) |

*requires the use of a 50 mm stand off

The instrument also measures in N/mm$^2$ and Newtons (unit of force). See ***Units*** (pg. 12).

## Returning for Service

*There are no user serviceable components. Any service must be performed by DeFelsko Corporation.*

*If you need to return the instrument for service, describe the problem fully and include reading results, if any. Be sure to include contact information including your company name, company contact, telephone number and fax number or email address.*

*Website: www.defelsko.com/support*

## Limited Warranty, Sole Remedy and Limited Liability

DeFelsko's sole warranty, remedy, and liability are the express limited warranty, remedy, and limited liability that are set forth on its website: www.defelsko.com/terms

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